FORM PTO-1390 (REV. 1-98)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER
3606-0113P

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
09/744077

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/05326	September 1, 1995	September 2, 1994

TITLE OF INVENTION
METHOD AND DEVICE FOR THE ANTENNA SELECTION IN A DIGITAL TELECOMMUNICATION SYSTEM

APPLICANT(S) FOR DO/EO/US
DE BENEDITTIS, Rossella; GIANCARLO, Rosina; BETTI, Alessandro; SALTINI, Giorgio

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.

2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.

3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39 (1).

4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date

5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))

    a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).

    b. ☒ has been transmitted by the International Bureau. WO 00/05827

    c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).

6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(3)).

7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(2)).

    a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).

    b. ☐ have been transmitted by the International Bureau.

    c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.

    d. ☒ have not been made and will not be made.

8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98./International Search Report, 1449 Form, w/ 3 references

12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. ☒ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.

14. ☐ A substitute specification.

15. ☐ A change of power of attorney and/or address letter.

16. ☒ Other items or information:
International Preliminary Examination Report
PCT Request
Three (3) sheets of formal drawings

	CALCULATIONS	PTO USE ONLY

17. ☒ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5):

Neither international preliminary examination fee (37 CFR 1.482)
nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO
and International Search Report not prepared by the EPO or JPO............ $1,000.00

International preliminary examination fee (37 CFR 1.482) not paid to
USPTO but International Search Report prepared by the EPO or JPO $860.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO
but international search fee (37 CFR 1.445(a)(2)) paid to USPTO........... $710.00

International preliminary examination fee (37 CFR 1.482) paid to USPTO
but all claims did not satisfy provisions of PCT Article 33(1)-(4) $690.00

International preliminary examination fee (37 CFR 1.482) paid to USPTO
and all claims satisfied provisions of PCT Article 33(1)-(4)................. $100.00

ENTER APPROPRIATE BASIC FEE AMOUNT = $ 860.00

Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492(e)). $ 130.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	10 - 20 =	0	X $18.00	$	0.00
Independent Claims	1 - 3 =	0	X $80.00	$	0.00
MULTIPLE DEPENDENT CLAIM(S) (if applicable)		No	+ $270.00	$	0.00
		TOTAL OF ABOVE CALCULATIONS =		$	990.00

Reduction of ½ for filing by small entity, if applicable.
Applicant claims Small Entity Status in accordance with 37 CFR 1.27. $

SUBTOTAL = $ 990.00

Processing fee of **$130.00** for furnishing the English translation later than ☐20 ☐30 months from the earliest claimed priority date (37 CFR 1.492(f)). + $

TOTAL NATIONAL FEE = $ 990.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property + $

TOTAL FEES ENCLOSED = $ 990.00

	Amount to be: refunded	$
	charged	$

a. ☒ A check in the amount of $ **990.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account. No. _____ in the amount of $_____ to cover the above fees.
A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-2448.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

Send all correspondence to:
Birch, Stewart, Kolasch & Birch, LLP   or Customer No. 2292
P.O. Box 747
Falls Church, VA 22040-0747
(703)205-8000

_____
SIGNATURE

MUTTER, MICHAEL K.
NAME

#29,680 (MKM)
REGISTRATION NO.

/djm 1/19/01

(REV. 12/11/2000)

PATENT
3606-0113P

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: DE BENEDITTIS et al.

Int'l. Appl. No.:   PCT/EP99/05326

Appl. No.:   New   Group:

Filed: January 19, 2001   Examiner:

For: METHOD AND DEVICE FOR THE ANTENNA
                    SELECTION IN A DIGITAL
                    TELECOMMUNICATION SYSTEM

PRELIMINARY AMENDMENT

BOX PATENT APPLICATION
Assistant Commissioner for Patents   January 19, 2001
Washington, DC 20231

Sir:

The following Preliminary Amendments and Remarks are respectfully submitted in connection with the above-identified application.

AMENDMENTS

IN THE SPECIFICATION:

Please amend the specification as follows:

Before line 1, insert --This application is the national phase under 35 U.S.C. § 371 of PCT International Application No. PCT/EP00/05326 which has an International filing date of September 1, 1995, which designated the United States of America.--

IN THE CLAIMS:

Please amend the claims as follows:

Claim 9, line 1, change "the previous claims" to --claim 1--

REMARKS

The specification has been amended to provide a cross-reference to the previously filed International Application.

The claims have been amended to remove the multiple claim dependency and to place the application into better form prior to examination.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By

Michael K. Mutter, #29,680

P.O. Box 747
MKM/djm   Falls Church, VA 22040-0747
3606-0113P   (703) 205-8000

(Rev. 04/19/2000)

1

"Method and Device for the Antenna Selection in a Digital Telecommunication System"

5   **Technical Field**

The present invention relates to digital telecommunication systems according to Time Division Multiple Access (TDMA), and in particular, but not exclusively, relates to systems operating according the DECT standard (Digital Enhanced Cordless Telecommunications).

10   More precisely, the present invention relates to a method and a device for the selection of an antenna used in the fixed radio station of such system.

In the following description reference will be made in particular to a DECT system, without that this should be limited thereto. The invention can be generally applied in systems where the connection between two transceiver units (a radiomobile or portable

15   unit or PP (Portable Part according to the DECT terminology) and a fixed radio station or RFP (Radio Fixed Part) is realized.

As already known, the DECT system includes a plurality of fixed radio stations distributed in a way to cover the interested areas and controlled by a centralised unit (CCFP, Central Control Fixed Part), and connected to a switching network which may

20   be the public one of the private type (PABX), and of portable units linking up via radio with the fixed radio stations, and being able to communicate with each other and with others fixed users connected to the telephone network. The links may be of the voice type or they may enable the exchange of data occupying the equivalent of one or more voice "channels".

25   At first, an exemplary DECT network architecture is schematically illustrated in Fig. 1.

It comprises groupings of h (in the example of the figure h = 4) fixed radio stations RFP (Radio Fixed Part) preferably connected to coppers (in the example 3 coppers) set up by connection or dorsal lines L through drop/insert devices DI. Without departing from the scope of the present invention, it turns obviously out to be possible to connect

30   in a star-shaped way each RFP to the CCFP eliminating the aforesaid connection lines, and therefore obviously also the Drop/Insert devices DI.

Each RFP can manage via radio a certain number of PPs, which generally are mobile.

AMENDED SHEET

The coppers end up at a TRAnScoder unit TRAS, and the latter is for example connected to the public network PSTN (Public Switching Telephone Network) through a Central Control Fixed Part (CCFP) associated to a switching network or a dedicaded switching module MEP.

5   Regarding the vocal signals, digital 64 Kbit/s channels typically set up the interface between the CCFP and the accessed network. To the CCFP unit a set of transcoders TRAS is associated providing for the conversion of the PCM codification (Pulse Code Modulation) on 8 bits used at the PSTN side into an ADPCM (Adaptive Differential Pulse Code Modulation) codification on four bits used at the DECT side. In this way two

10 32 Kbit/s channels can be mapped onto each 64 Kbit/s channel.

The 2,048 Mbit/s (bi-directional) connection link connecting the CCFP to the different RFPs supports therefore 48 voice channels plus a predetermined number of synchronisation and signalling channels.

The area covered by a fixed radio station or cell is generally rather reduced, arriving

15 also to a radio coverage radius of tens or hundreds of metres. Typical applications of the personal telephony systems can be found in industrial plants where they may substitute the installation of a cabled network, in shopping centres or urban centres where they may advantageously substitute public telephone boxes and so on.

The telecommunication network for personal telephony is of the digital type. The

20 radio access technology is of the type FDMA (Frequency Division Multiple Access) - TDMA (Time Division Multiple Access) - TDD (Time Division Duplex).

The system is of the TDD type as the transmission and reception direction are time divided. More precisely, as illustrated with reference to Fig. 2, the time frame interval of 10 milliseconds is divided into two halves: usually during the first 5 ms (i.e. in the first

25 half frame) the fixed radio station transmits and the portables receive, and in the following 5 ms (i.e. in the second half frame) the contrary happens. Each half frame is set up by 12 time channels or time slots, hereafter for the sake of brevity also referred to as "slot", (from which it comes that DECT is a TDMA system, set up by 420 (or in some cases by 424) bits. The slots are transmitted or received using 10 (or more)

30 different frequencies (from where it results that DECT is an FDMA system as well, which allows to provide to the system up to 120 (or more) radio channels (where a radio channel is identified by the pair (time slot + frequency).

The DECT multiframe is illustrated in Fig.3 and has a duration of 160 ms, so that it includes 16 frames of 10 msec each as described in Fig. 2

For further details on the DECT system please refer to the specifications established by the European Telecommunications Standards Institute, briefly ETSI (Ref. EN 300 175 specification).

In a DECT system the fixed radio station or RFP has an antenna system which may have different configurations:

- N antennas (with N equal to at least 2) for management in space diversity and/or polarisation of the received signal;

- a set of sectorial antennas, that is a system in which a plurality of antennas is connected to each RFP where every antenna of the set lightens just a portion (or sector) of the entire cell or of the RFP coverage area (usually trisection antennas are defined which implies therefore the use of antennas with a coverage angle of 120°);

- a set of phased antennas suitable to set up a radiation diagram with variable direction and gain.

Moreover the RFP includes a selection device or appliance among the antennas enabling the selection of the most suitable one that is that antenna which assures the better quality for the detected signal.

In fact the transmitted signal, especially in an urban environment, may be affected by the so-called fading phenomenon constituted by amplitude and phase variations of the electromagnetic field or of the power of the detected signal due to changeable propagation conditions. Because of such a phenomenon, in a predetermined instant the signal can be received with major intensity from a predetermined antenna (or from a predetermined first group of antennas) while in a following instant this signal can be received with major intensity from a second antenna (or from another predetermined second group of antennas).

Therefore mainly due to this phenomenon, it is necessary to choose time by time the antenna (or the antennas group) supplying the best signal.

Background Art

According to the known art the antenna selection appliance is able to manage an antenna switching according to two or more methods.

In particular the switching may occur based on a switching method, called "time switch diversity" or it can be based on a switching method called "instant diversity".

The switching method "time switch diversity" is based on the concept for which, in case the reception of a signal from an antenna (or antenna group) has to be considered

failed (according to a preset failure criterion), then in the next received frame a different antenna (or antenna group) is selected at the RFP (see also Fig. 2). The predetermined failure criterion may be of the proprietary type and could be based for example on the estimation of the received field strength or RSSI (Received Signal Strength Indicator) or, more generally on the estimation of the perceived signal quality.

This switching method "time switch diversity" presents the disadvantage that reaction can be slow in respect to the aforesaid fading phenomenon that should be hindered.

The already known switching method named "instant diversity" is instead realised by a fast sampler able to carry out an RSSI measurement in a short time period equal to 2-3 µs with the possibility to switch the antenna in a comparable amount of time. For example, always according to the present state of the art it is possible to sample a signal at the beginning of the slot carrying out a measurement on the antenna 1 for about 3 µs, to change the antenna in a very short time, equal to about 1 - 2 µs and then sample the received signal on the other antenna.

The "instant diversity" switching method has the advantage compared to "Time switch diversity" method that makes it possible to understand during the first 10 µs which is the best antenna and which will be selected to detect the remaining part of the signal.

However it is necessary to note that the "instant diversity" method presents certain critical aspects from the implementation point of view, because such operations are carried out at the beginning of the slot, sacrificing a few of those bits (i.e. the preamble bits) useful for the timing reconstruction and which do not bring any user data. On the other hand it cannot be carried out during the slot, because the antenna switching introduces a discontinuity in the demodulation of the slot which would make lose part of its informative content.

There has also been the proposal to use an extended preamble consisting in the repetition, at the beginning of the slot, of the preamble field in order to dedicate the first part of this field to the selection of the antenna and the second part to the specific function for which such a preamble has been foreseen by ETSI standard (like f.i. the timing reconstruction and alignment between the two communicating radio transceivers. However it is necessary to point out that if such a solution to extend preamble field makes it possible to solve the above-mentioned problems, it also defines the turning up of a further drawback consisting in the shortening of the inter slot

guard periods, which means major interference among DECT systems which are not synchronised each other (e.g. because they do not refer to the same operator) and the shortening of the propagation range.

A combination of "instant diversity" and preamble-based antenna selection technique is disclosed in the paper "Predetection quality diversity scheme for DECT outdoor applications S. Safavi and L.B. Lopes, ELECTRONICS LETTERS, vol.32, no. 11, 23 May 1996 (1996-05-23), pages 966-968, XP000599112 ISSN: 0013-5194.

This additional antenna selection technique has therefore the drawbacks above mentioned in connection with said instant diversity tecnique and in connection with said extended preamble tecnique.In the case of a system that foresees sectorial antennas it is also known to carry out the selection of antennas in such array. More precisely, at the moment when the connection on the antenna in use turns out to be degraded, a switching operation can be carried out on other antennas to see if the connection quality improved.

But such solution includes however the drawback that the choice requires to realise an RSSI measuring on a slot for each antenna of the array, and therefore it may last rather a lot of slots; too many bursts could be sacrificed because of having tried some antennas not suitable for this link. Moreover the measurements are heterogeneous with each other as they are carried out at different instants.

Furthermore it is necessary to point out that, as there is the possibility to carry out an RSSI measurement, methods have been proposed for the estimation of the speed of a mobile user which are based on the received field strength variation. Such finding is important for the handover between a DECT cell and another one of the GSM system when the mobile user moves quickly in relatively small cells.

Object of the invention

The object of the present invention is to overcome the above-mentioned problems and limitations, and in particular to propose a better method and a device for the selection of the most suitable antenna. Advantageously the method according to the invention allows also obtaining an estimation of the speed of the mobile user.

Summary of the invention

The present invention achieves these objects by means of a method with the features listed in claim 1 and by means of a device having the features listed in claim 10.

Additional features which are belived to be novel are set forth with particularity in the

appended claims.

According to the method of the invention, a series of measurements is carried out during the reception of the useful signal which does not overcome the adopted criterion to define the correlation of the slots and which will be declared as lost (so-called "SYNC FAILURE").

Now it will be illustrated the SYNC FAILURE concept. The DECT standard presents an organised frame, so that the receiver, at the moment of receiving a useful signal from one radio channel, has to:

1. reconstruct first of all the phase timings (bit and slot) from the preamble field (16 + 16 bits),

2. and then demodulate the informative content (field A and field B).

Some of these operations may fail, because of the different factors influencing the propagation such as link budget, selective fading, Doppler effect, etc.

In particular there is a key function for the detection of the transmitted signal (said "Burst") from a radio channel, which can be identified in the correlation operation. Every RFP (and, of course, every PP) is therefore provided with a correlation circuit based on criteria which can be manufactured dependant. When the found out correlation value does not overcome these criterions then the received burst is declared lost (SYNC FAILURE).

According to the previous technique no other operation will be carried out on these lost bursts except the one of counting them as such (WER calculation, Word Error Rate), taking for granted in general, that the content cannot be recovered and that the selected antenna by which they have been received, was the worst one.

Applying instead the innovative method the present invention is based on, that is executing some measurements on the received bursts having caused the sync failure, it turns out to be possible to achieve the following advantages:

· the measures are not destructive for the useful signal as they are carried out on unusable slots;

· it is possible to carry out in a very short time the measures related to the different antennas so that the selection of the most suitable antenna can be done in due time;

· measures carried out in the lost slots are more significant because they take place together with a criticality in progress that has to be improved and resolved.

Brief description of the drawings

The invention will now be described in a more detailed way with reference to a

preferred but not limiting embodiment illustrated with reference to the enclosed drawings, in which:

Fig. 1, already described, shows the network architecture of a DECT system;

Fig. 2, already described, shows the frame structure of the illustrated DECT system;

Fig. 3, already described, shows the multiframe structure of the DECT system;

Fig. 4 shows a flow chart of the antenna selection method according to the invention.

The method according to the invention foresees that in the case of missed correlation all available antennas will be scanned sequentially carrying out a certain number K of cycles.

The number K of cycles depends on the minimum duration of the measurement on each single antenna, on the minimum antenna switching time and on the number of available antennas according to the following relation:

$$K = (420 * 868000 - X - Y) / (N*Ta+(N-1)*TC)$$

where:

"420" is the number of bits in a time slot

"868000" is the bit time duration [μS]

"K" is the number of measurement cycles on the slot

"N" is the number of antennas

"Ta" is the measurement time [μS] on the single antenna

"Tc" is the switching time [μS] among the antennas

"X" is the inferior limit [μS] of the correlation time window

"Y" is the superior limit [μS] of the correlation time window

During said scanning period the RSSI values from the different antennas are measured, and therefore for each slot a table of the following type is collected:

CYCLE 1

ANT 1   RSSI= [ ] dBm

ANT 2   RSSI= [ ] dBm

....

ANT N   RSSI= [ ] dBm]

Ta = [ ] μs

Tc = [ ] μs

CYCLE 2

ANT 1   RSSI= [ ] dBm

ANT 2   RSSI= [ ] dBm

5   ....

ANT N   RSSI= [ ] dBm

$Ta = [ ] \mu s$

$Tc = [ ] \mu s$

  ....

10

CYCLE K

ANT 1   RSSI= [ ] dBm

ANT 2   RSSI= [ ] dBm

  ....

15 ANT N   RSSI= [ ] dBm

$Ta = [ ] \mu s$

$Tc = [ ] \mu s$

    Referring to Fig. 4, the method foresees the following steps:

20   Step 1: verify if the power variability of each antenna in the period of one slot is comprised in a preset range, for example ±3 dBm.

    Step 2: in the affirmative case, that is in stationary slot conditions, step 2 is started off to check if the power variability among the different antennas is comprised in a predetermined range, for example ±3 dBm.

25   In the negative case, according to the type of antenna(s), which has caused such result, the choice is carried out (antenna(s) selection). More precisely, it will be selected that antenna which turns out to be the best regarding the detected RSSI (i.e. which shows the major and stable RSSI value).

    Step 3: In the affirmative case, always at step 2, at step 3 a counter $J(J=J+1)$ is

30 increased, and at

Step 4: it will be stated, if the J counter value is superior to a fixed threshold (J>Thre.?); in the negative case the table will be reconsidered, while in the positive case at

Step 5: the table of the channels will be updated, and at

Step 6: the bearer handover will be required as the diversity does not turn out to be

efficient.

If the answer to step 1 is negative, that is if the power variability of each antenna during the period of a slot is high, then at

Step 7: a counter I will be increased (I=I+1), and at

Step 8: it will be checked, if the I counter value overcomes a preset threshold (I>Tresh.?): in the negative case the table will be considered again, while in the positive case at

Step 9: the mode handover will be required to the PP, as this means that the portable set is moving with an appreciable speed compared to the dimensions of the cell and therefore defining frequent handover creates problems to the serving system. For this reason if the PP is of the dual band type, that is able either to operate according to the GSM and the DECT standard, then the PP will be forced to hand-over towards the GSM system, its speed being reasonably compatible with the operating modalities of such a system and incompatible with the operating modalities of the DECT system.

The measures correlated to the innovative method according to the present invention supply therefore the following additional information:

1) SWITCH OR INSTANT DIVERSITY

1) confirmation of the hypothesis that the used antenna is the worst (the hypothesis is based on the fact that the burst has not been received correctly).

2) Efficiency of the antenna diversity. In the case the measurements carried out on different antennas are comparable, that is contained in a range of + / - 3 dB) and still the transmitted burst is not correctly detected (i.e. it has been lost) it is preferable not to insist on the use of the diversity, but it is preferable to suggest the PP to carry out a handover.

3) The event with similar measurements could be stored as a statistic counter to value the entity of the improvement introduced by the antenna diversity.

A further advantage of this improvement consists in the fact that the extracted information is much more significant and efficient the more critical the situation of the channel and therefore the number of lost bursts are.

However nothing prohibits, in the case of finding possible anomalies, to extend these measurements outside of the lost bursts, sacrificing some correctly detected bursts or using other techniques to save the situation.

2) SELECTION IN A SECTORIAL ARRAY

AMENDED SHEET

During a slot it is possible to value the power received from all antennas of the array, selecting the one with the major received power.

The advantages in this case are the following:

1. the measurements are carried out in a very short time and therefore they provide
5   homogeneous information;

2. time consuming researches by attempt are avoided on antennas which reception turns out to be of bad quality;

3. estimation of the mobile speed.

Regarding the estimation of the speed, this can happen according to two modalities.

10 When the duration of the slot is comparable to the duration of the fading phenomenon, the slot fading conditions can be considered as stationary for the mobile speed below 10-15 [KM] / h.

But when the duration of the slot is too short compared to the fading phenomenon, the measurement is used as a trigger for other measurements.

15 Although a particular embodiment of the present invention has been described, it should be understood that the present invention is not limited thereto since other embodiments may be made by those skilled in the art without departing from the scope thereof. It is thus contemplated that the present invention encompasses any and all such embodiments covered by the following claims.

20

CLAIMS

1. Method for the antenna selection in the fixed radio station (RFP) of a digital telecommunication system of the TDMA type, in which the signals are arranged in frames with a preset duration, and in each frame a predetermined number of time slots are assigned,

said system including a plurality of radiomobile units (PP), and said fixed radio station (RFP), which at its turn includes correlation means, i.e. means adapted to perform the correlation operation at the moment of receiving of each time slot of the frame of said digital signal and means adapted to select one antenna, or a plurality of antennas, connected to them, and in particular:

- N antennas, with N≥1, for the management in space diversity and/or polarisation of the received signal, and/or

- an array of sectorial antennas, and/or

- an array of phased antennas,

characterised in that it comprises the following operational steps:

a) verifying if the correlation operation carried out by said correlation means has been successful or not;

b) in the case of failed correlation, sequential scanning within the same time slot of all available antennas and repeatedly measuring the received field strength or RSSI for a predetermined number K of measuring cycles;

c) compiling a table containing for each antenna K measured RSSI values;

d) verifying if the power variability of each antenna during the period of a time slot is included in a first preset range;

e) in the affirmative case, verifying if the power variability between the different antennas stays in a second preset range comparing the data contained in the above-mentioned table;

f) if the verification according to the previous step e) has a negative result, starting the selection of the antenna/s applying a criterion which takes into consideration the result of the comparison according to the previous step e).

2. Method according to claim 1, characterised in that said fixed radio station (RFP] includes at least a pair of space diversity antennas and in that the criterion according to step f) consists in the choice of the antenna which received field strength value turns out to be the highest one among all measured ones.

3. Method according to claim 1, characterised in that said fixed radio station (RFP) includes at least an array of sectorial antennas, and in that the criterion according to step f) consists in the choice of the antenna, which received field strength value turns out to be the highest one among all measured ones.

4. Method according to claim 1, characterised in that, if said verification phase according to step d) does not have an affirmative result, it comprises a further step to verify if such value overcomes a first preset threshold, and if not the cycle of operations will be repeated starting from the above-mentioned step b).

5. Method according to claim 4, characterised in that, if the radiomobile unit is of the dual mode type and if said further checking step to verify if said value is higher than said first preset threshold has a positive result, also the operational modality change request of the radiomobile unit will be started off (mode handover).

6. Method according to claim 1, characterised by fact that, if said verification phase according to step e) points out an overcoming of said second preset range, a further step is foreseen to verify if the power difference among the different antennas overcomes a second preset threshold, and in the negative case, the cycle of operations will be repeated starting from the above-mentioned step b).

7. Method according to claim 6, characterised in that, if said further step to verify if the difference of power among the different antennas overcomes a second preset threshold has a positive result, then also the request to change the bearer in use will be started off (bearer handover).

8. Method according to claim 1, characterised in that said number K of measuring cycles is calculated according to the following formula:

$$K = (420 * 868000 - X - Y) / (N*Ta+(N-1)*TC)$$

where:

- "420" is the number of bits in a time slot;
- "868000" is the bit time duration [µS];
- "N" is the number of antennas;
- "Ta" is the measurement time [µS] on the single antenna;
- "Tc" is the switching time [µS] among the antennas;
- "X" is the inferior limit [µS] of the correlation time window;
- "Y" is the superior limit [µS] of the correlation time window.

9. Method according to the previous claims, characterised in that said first and second preset ranges are equal to ± 3 dBm.

13

10. Device for the antenna selection in the fixed radio station (RFP) of a digital telecommunication system of the TDMA type, in which the signals are arranged in frames with a predetermined duration, and in each frame a predetermined number of time slots will be assigned, said system including a plurality of radiomobile units (PP) and said fixed station (RFP) which at its turn includes means adapted to carry out the correlation operation at the moment of receiving each time slot of the frame of said digital signal and means for the selection of one antenna or of a plurality of antennas to which are connected:

- N antennas for the management in space diversity and/or polarisation of the received signal, and/or
- an array of sectorial antennas, and/or
- a phased array of antennas,

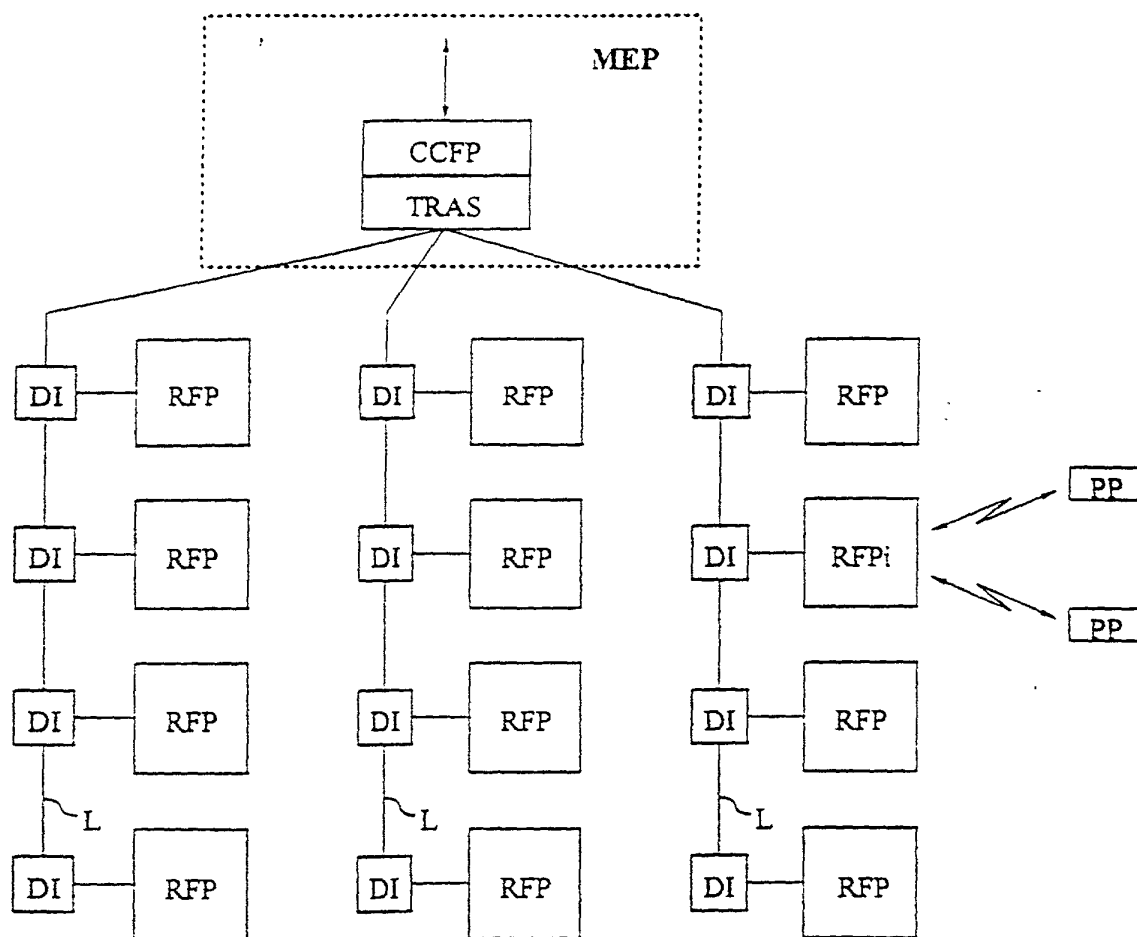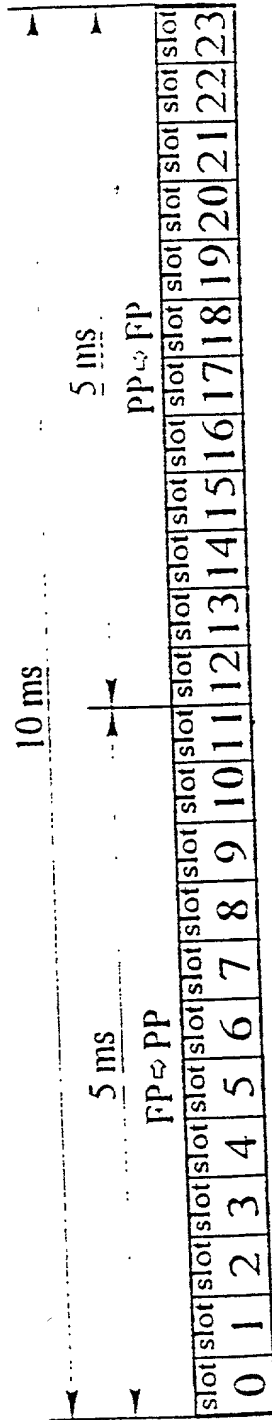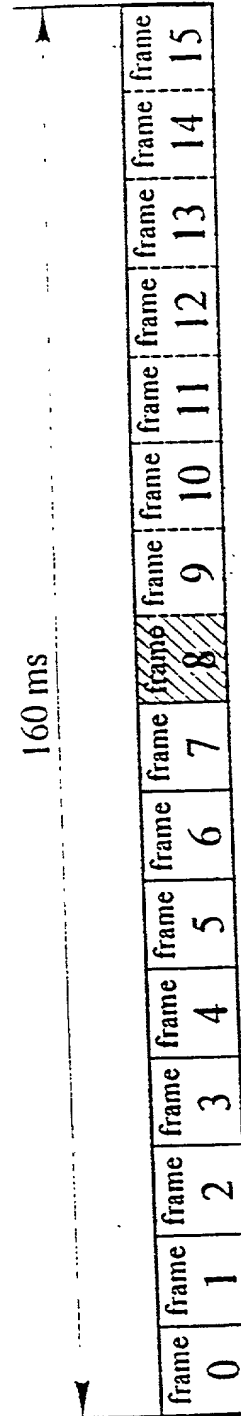characterised in that it operates according to the method disclosed in claim 1.

1/3

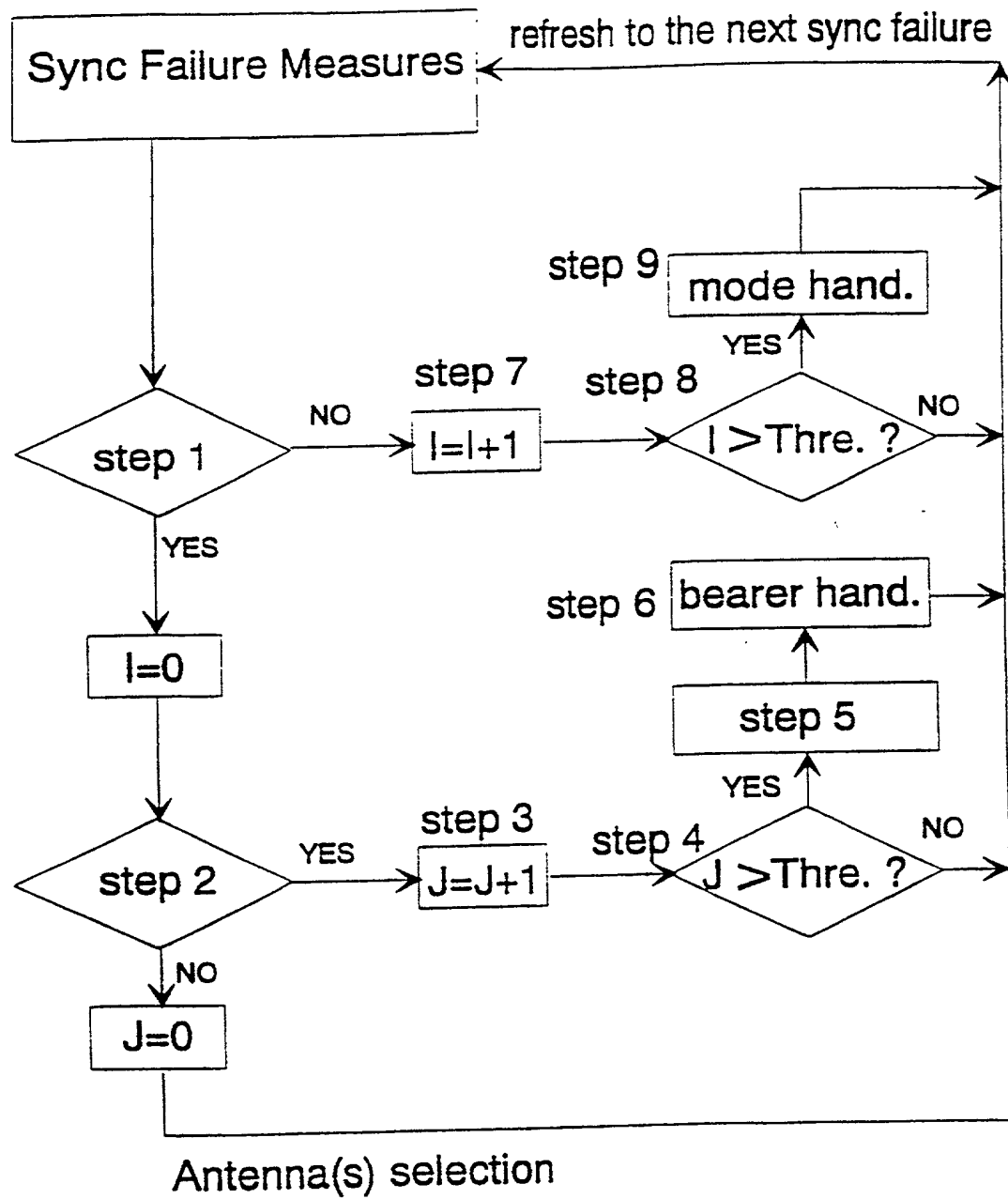*Fig. 1*

Fig. 2

Fig. 3

refresh to the next sync failure

Sync Failure Measures

step 9   mode hand.

YES

step 7   step 8

NO   I=I+1   I >Thre. ?   NO

step 1

YES

I=0

step 6   bearer hand.

step 5

YES

step 3   step 4

step 2   YES   J=J+1   J >Thre. ?   NO

NO

J=0

Antenna(s) selection

Fig. 4

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COMBINED DECLARATION AND POWER OF ATTORNEY

FOR PATENT AND DESIGN APPLICATIONS

**PLEASE NOTE:
YOU MUST
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FOLLOWING:**

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated next to my name; that I verily believe that I am the original, first and sole inventor (if only one inventor is named below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Insert Title: ➡ Method and device for the antenna selection in a digital telecommunication system

**Fill in Appropriate
Information -
For Use Without ➡
Specification
Attached:**

the specification of which is attached hereto. If not attached hereto,
the specification was filed on January 19, 2001 _____ as
United States Application Number 09/744,077 _____; and /or

the specification was filed on JULY 16 1999 _____ as PCT
International Application Number PCT/EP99/05326 _____; and was
amended under PCT Article 19 on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (six months for designs) prior to this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by me or my legal representatives or assigns, except as follows.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

**Insert Priority
Information:
(if appropriate)** ➡

Prior Foreign Application(s)

(Number)	(Country)	(Month/Day/Year Filed)	Priority Claimed
MI98A001674	ITALY	JULY 21, 1998	☒ Yes ☐ No
(Number)	(Country)	(Month/Day/Year Filed)	☐ Yes ☐ No
(Number)	(Country)	(Month/Day/Year Filed)	☐ Yes ☐ No
(Number)	(Country)	(Month/Day/Year Filed)	☐ Yes ☐ No
(Number)	(Country)	(Month/Day/Year Filed)	☐ Yes ☐ No

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

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(Application Number) _____ (Filing Date) _____

(Application Number) _____ (Filing Date) _____

All Foreign Applications, if any, for any Patent or Inventor's Certificate Filed More Than 12 Months (6 Months for Designs) Prior To The Filing Date of This Application:

**Insert Requested
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(if appropriate)** ➡

Country	Application No.	Date of Filing (Month/Day/Year)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

**Insert Prior U.S.
Application(s):
if any** ➡

(Application Number)	(Filing Date)	(Status - patented, pending, abandoned)

I hereby appoint the following attorneys to prosecute this application and/or an international application based on this application and to transact all business in the Patent and Trademark Office connected therewith and in connection with the resulting patent based on instructions received from the entity who first sent the application papers to the attorneys identified below, unless the inventor(s) or assignee provides said attorneys with a written notice to the contrary:

Terrell C. Birch	(Reg. No. 19,382)	Raymond C. Stewart	(Reg. No. 21,066)
Joseph A. Kolasch	(Reg. No. 22,463)	James M. Slattery	(Reg. No. 28,380)
Bernard L. Sweeney	(Reg. No. 24,448)	Michael K. Mutter	(Reg. No. 29,680)
Charles Gorenstein	(Reg. No. 29,271)	Gerald M. Murphy, Jr.	(Reg. No. 28,977)
Leonard R. Svensson	(Reg. No. 30,330)	Terry L. Clark	(Reg. No. 32,644)
Andrew D. Meikle	(Reg. No. 32,868)	Marc S. Weiner	(Reg. No. 32,181)
Joe McKinney Muncy	(Reg. No. 32,334)		
C. Joseph Faraci	(Reg. No. 32,350)	Donald J. Daley	(Reg. No. 34,313)

Send Correspondence to:

BIRCH, STEWART, KOLASCH & BIRCH, LLP

Customer No: 2292

P.O. Box 747 • Falls Church, Virginia 22040-0747
Telephone: (703) 205-8000 • Facsimile: (703) 205-8050

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

GIVEN NAME ROSSELLA	**FAMILY NAME** DE BENEDITTIS	**INVENTOR'S SIGNATURE** *Rosella De Benedith*	**DATE** 22-01-2001
Residence (City, State & Country) 20020 BARBAIANA DI LAINATE – ITALY ITX			**CITIZENSHIP** ITALIAN
POST OFFICE ADDRESS (Complete Street Address including City, State & Country) Via delle Margherite, 9 – 20020 Barbaiana di Lainate – Italy			
GIVEN NAME GIANCARLO	**FAMILY NAME** ROSINA	**INVENTOR'S SIGNATURE** *Rosina Giancarlo*	**DATE** 22/01/2001
Residence (City, State & Country) 20018 SEDRIANO – ITALY ITX			**CITIZENSHIP** ITALIAN
POST OFFICE ADDRESS (Complete Street Address including City, State & Country) Cascina Legoratta – 20018 Sedriano – Italy			
GIVEN NAME ALESSANDRO	**FAMILY NAME** BETTI	**INVENTOR'S SIGNATURE** *Alessandro Betti*	**DATE** 28/01/2001
Residence (City, State & Country) 62100 MACERATA – ITALY ITX			**CITIZENSHIP** ITALIAN
POST OFFICE ADDRESS (Complete Street Address including City, State & Country) Via Rosetani, 24 – 62100 Macerata – Italy			
GIVEN NAME GIORGIO	**FAMILY NAME** SALTINI	**INVENTOR'S SIGNATURE** *Giorgio Saltini*	**DATE** 14/02/2001
Residence (City, State & Country) 20156 MILANO – ITALY ITX			**CITIZENSHIP** ITALIAN
POST OFFICE ADDRESS (Complete Street Address including City, State & Country) Via Dario Niccodemi, 1 – 20156 Milano – Italy			
GIVEN NAME	**FAMILY NAME**	**INVENTOR'S SIGNATURE**	**DATE**
Residence (City, State & Country)			**CITIZENSHIP**
POST OFFICE ADDRESS (Complete Street Address including City, State & Country)			

Full Name of First or Sole Inventor: 1-00
Insert Name of Inventor
Insert Date This Document is Signed
Insert Residence
Insert Citizenship
Insert Post Office Address

Full Name of Second Inventor, if any 2-00
see above

Full Name of Third Inventor, if any 3-00
see above

Full Name of Fourth Inventor, if any 4-00
see above

Full Name of Fifth Inventor, if any
see above

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(USPTO Approved 3-90)
(Revised 8-97)

* DATE OF SIGNATURE